BIMONTHLY REPORT

RESEARCH STUDY ON STABILIZATION AND CONTROL

MODERN SAMPLED-DATA CONTROL THEORY

SYSTEMS RESEARCH LABORATORY

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PREPARED FOR GEORGE C. MARSHALL SPACE FLIGHT CENTER

HUNTSVILLE, ALABAMA

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RESEARCH STUDY ON STABILIZATION AND CONTROL — MODERN SAMPLED-DATA CONTRO'. THEORY

SUBTITLE: DESIGN OF THE LARGE SPACE TELESCOPE SYSTEM

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2. Prediction by Numerical Methods of Self-Sustained Oscillations in a Two-Axis Model of the Nonlinear Sampled-Data LST System

2-1. Introduction

It has been demonstrated in [2] that the stability equations as a result of the describing function analysis may be solved by a numerical-iterative technique. In Chapter 1, the numerical technique is applied to the prediction of self-sustained oscillations in a two-axis model of the nonlinear LST system with continuous-data. In this chapter the same numerical technique will be extended to the prediction of self-sustained oscillations in a two-axis model of the nonlinear LST system with sampled-data.

In the two-axis model of the LST system, the system contains two nonlinearities, and the general form of the stability equation in the sampled-data case is

$$1 + \hat{G}_B(T,n)N(A,n,\phi) + \hat{G}_C(T,n)N^2(A,n,\phi) = 0 \tag{2-1}$$

where $G_B(T,n)$ and $G_C(T,n)$ are transfer functions which describe the linear elements of the coupled systems, and $N(A,n,\phi)$ represents the discrete describing function of the CMG nonlinearity. The amplitude of the sinusoidal signal at the input of the nonlinearities is denoted by A; T is the sampling period in second, and n is the integer which relates the period of the sustained oscillation to the sampling period; ϕ is the phase angle of the input sinusoid. Therefore,

$$T_C = nT = \text{period of sustained oscillation} \tag{2-2}$$

or

$$\omega_C = \frac{2\pi}{nT} = \text{frequency of sustained oscillation in rad/sec} \tag{2-3}$$

2-2. The Sampled-Data Two-Axis LST System Model and Its Stability Equation

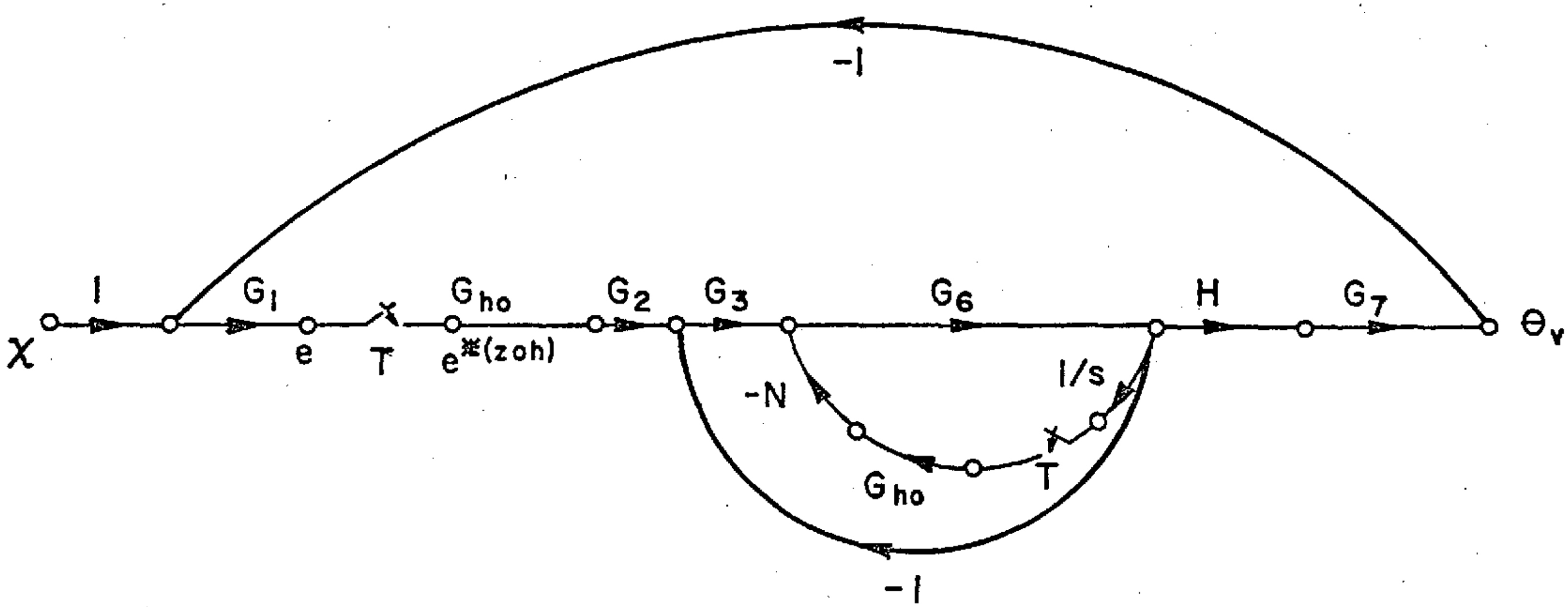
Figure 2-1 illustrates the signal flow graph representation of the sampled-data single-axis LST system. The nonlinear friction of the CMG is modeled by the branch with the gain N, where strictly, N denotes the discrete describing function $N(A,n,\phi)$. The sample-and-hold at the input of the nonlinearity is added for analytical purposes, so that the overall system may be treated by the z-transform method. Since the actual system does not have the sample-and-hold preceding N, the system configuration of Fig. 2-1 should be considered as an approximation to the sampled-data single-axis LST system.

Figure 2-2 shows the two-axis model of the LST system, with the coupling made at the output stages. The coupling coefficients K_2 and K_3 may be varied for various degrees of coupling between the two single-axis systems.

For the study of self-sustained oscillations, we set $x_1 = x_2 = 0$. From the signal flow graph of Fig. 2-2, the following cause-and-effect relationships are written for the variables at the outputs of the four samplers:

$$E_1^* = -A_1^*E_1^* + A_3^*N^*X_1^* + A_2^*E_2^* - A_4^*N^*X_2^* \tag{2-4}$$

$$E_2^* = -A_1^*E_2^* + A_3^*N^*X_2^* + A_2^*E_1^* - A_4^*N^*X_1^* \tag{2-5}$$



$$G_3(s) = \frac{K_p s + K_I}{s}$$

$$G_6(s) = \frac{1}{J_G s}$$

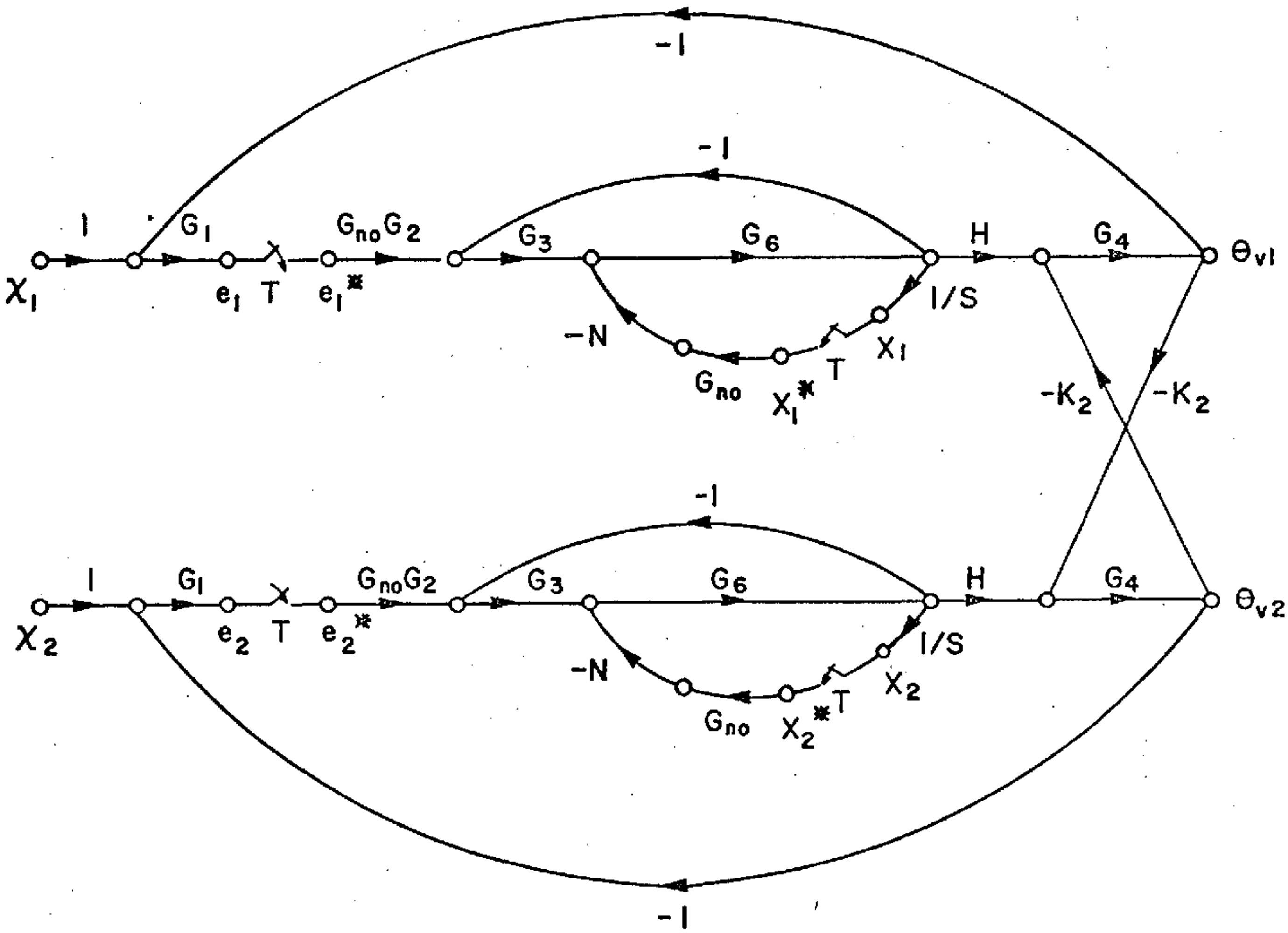
$$G_7(s) = \frac{1}{J_V s^2}$$

$$G_{ho}(s) = \frac{1 - e^{-Ts}}{s}$$

$$G_1(s) = K_o + K_1 s$$

$$G_2(s) = \frac{K_I}{K_p s + K_I}$$

Figure 2-1. The single-axis sampled-data LST system model.



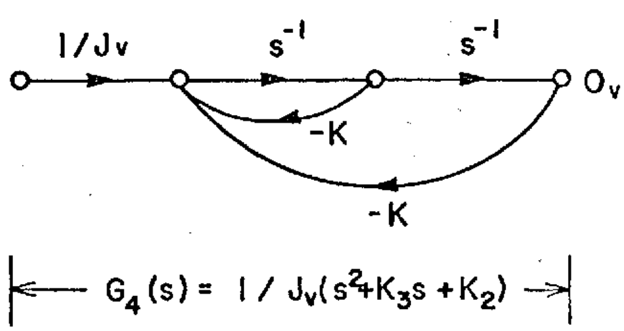


Figure 2-2. The two-axis sampled-data LST system model.

$$X_1^* = -B_1^* N^* X_1^* + B_2^* E_1^* \tag{2-6}$$

$$X_2^* = -B_1^* N^* X_2^* + B_2^* E_2^* \tag{2-7}$$

where

$$A_1 = \frac{G_{ho} G_1 G_2 G_3 G_4 G_6 H \Delta_1}{\Delta_o} \tag{2-8}$$

$$A_2 = \frac{G_{ho} G_1 G_2 G_3 G_4^2 G_6 H K_2 \Delta_1}{\Delta_o} = A_1 G_4 K_2 \tag{2-9}$$

$$A_3 = \frac{G_{ho} G_1 G_4 G_6 H \Delta_1}{\Delta_o} \tag{2-10}$$

$$A_4 = \frac{G_{ho} G_1 G_4^2 G_6 H K_2 \Delta_1}{\Delta_o} = A_3 G_4 K_2 \tag{2-11}$$

$$B_1 = \frac{G_{ho} G_6 \Delta_2}{s \Delta_o} \tag{2-12}$$

$$B_2 = \frac{G_{ho} G_2 G_3 G_6 \Delta_2}{s \Delta_o} = B_1 G_2 G_3 \tag{2-13}$$

$$\Delta_1 = 1 + G_3 G_6 \tag{2-14}$$

$$\Delta_o = 1 + 2G_3 G_6 - K_2^2 G_4^2 + G_3^2 G_6^2 - 2G_3 G_4^2 G_6 K_2^2 - G_3^2 G_4^2 G_6^2 K_2^2 \tag{2-15}$$

$$\Delta_2 = 1 + G_3 G_6 - G_3 G_6 K_2^2 G_4^2 - K_2^2 G_4^2 \tag{2-16}$$

In the last nine equations all functions are functions of s. The sampled signal flow graph of the system is drawn in Fig. 2-3 using Eqs. (2-4) through (2-7).

The determinant of the sampled signal flow graph is obtained from Fig. 2-3 by use of Mason's gain formula. The expression is given in terms of the z-transform functions:

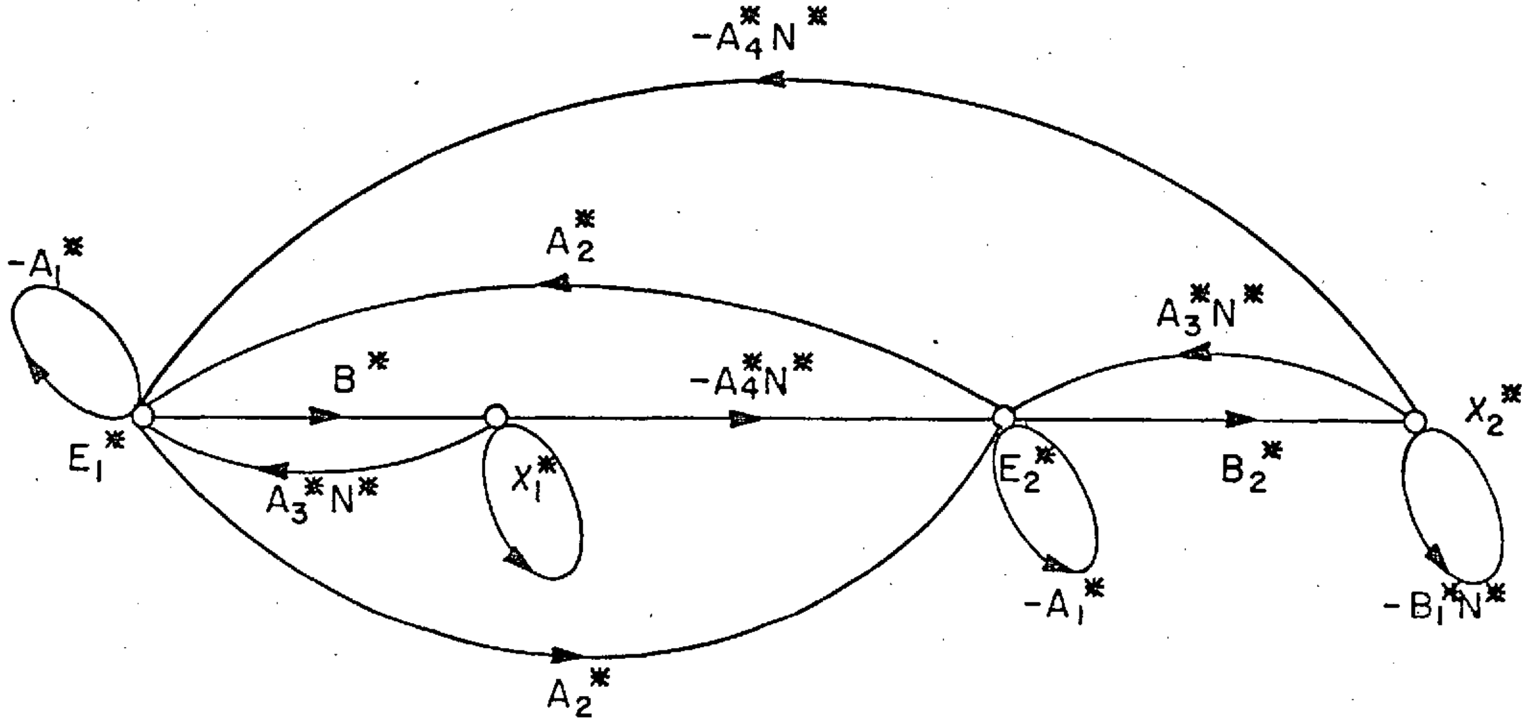


Figure 2-3. Sampled signal flow graph of the two-axis sampled-data LST system.

$$\Delta(z) = [1 + 2A_1(z) - A_2^2(z) + A_1^2(z)] + 2N(A,n,\phi)[B_1(z) - B_2(z)A_3(z) + A_2(z)B_2(z)A_4(z) + 2A_1(z)B_1(z) - A_1(z)A_3(z)B_2(z) + A_1^2(z)B_1(z) - A_2^2(z)B_1(z)] + N^2(A,n,\phi)[B_1^2(z) - A_4^2(z)B_2^2(z) - 2B_1(z)B_2(z)A_3(z) + A_3^2(z)B_2^2(z) + 2A_2(z)A_4(z)B_1(z)B_2(z) + 2A_1(z)B_1^2(z) - 2A_1(z)A_3(z)B_1(z)B_2(z) + A_1^2(z)B_1^2(z) - A_2^2(z)B_1^2(z)] \tag{2-17}$$

The components of $\Delta(z)$ are determined as follows:

$$A_1(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{K_I H J_V(K_o + K_1 s)(J_G s^2 + K_p s + K_I)(s^2 + K_3 s + K_2)}{s\Delta_{op}}\right\} \tag{2-18}$$

$$A_2(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{K_I K_2 H(K_o + K_1 s)(J_G s^2 + K_p s + K_I)}{\Delta_{op}}\right\} \tag{2-19}$$

$$A_3(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{H J_V(K_o + K_1 s)(J_G s^2 + K_p s + K_I)(s^2 + K_3 s + K_2)}{\Delta_{op}}\right\} \tag{2-20}$$

$$A_4(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{H K_2(K_o + K_1 s)(J_G s^2 + K_p s + K_I)}{\Delta_{op}}\right\} \tag{2-21}$$

$$B_1(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{(J_G s^2 + K_p s + K_I)[J_V^2(s^2 + K_3 s + K_2)^2 - K_2^2]}{s\Delta_{op}}\right\} \tag{2-22}$$

$$B_2(z) = (1 - z^{-1})\mathfrak{z}\left\{\frac{K_I(J_G s^2 + K_p s + K_I)[J_V^2(s^2 + K_3 s + K_2)^2 - K_2^2]}{s^2\Delta_{op}}\right\} \tag{2-23}$$

$$\Delta_{op} = [J_G^2 s^4 + 2K_p J_G s^3 + (K_p^2 + 2K_I J_G)s^2 + 2K_p K_I s + K_I^2][J_V^2(s^2 + K_3 s + K_2)^2 - K_2^2] \tag{2-24}$$

The expressions for the discrete describing function of the CMG nonlinearity, $N(A,n,\phi)$, may be found in [2]. In the present case, since the two axes are considered to be identical, and the couplings are symmetric, it is assumed that the amplitudes of the input signals at the two nonlinearities are identical.

The stability equation is obtained by setting $\Delta(z)$ of Eq. (2-17) to zero. It is apparent that $\Delta(z) = 0$ is of the form:

$$\Delta(z) = 1 + G_A(z) + G_B(z)N(A,n,\phi) + G_C(z)N^2(A,n,\phi) = 0 \tag{2-25}$$

which can be written as

$$1 + \hat{G}_B(T,n)N(A,n,\phi) + \hat{G}_C(T,n)N^2(A,n,\phi) = 0 \tag{2-26}$$

by dividing both sides of the equation by $1 + G_A(z)$, and setting

$$z = e^{j2\pi/n} \tag{2-27}$$

Equation (2-26) shows that in the sampled-data system, there are four variable parameters in the stability equation in T, n, A, and ϕ, whereas in the continuous-data system there are only two variables in A and ω.

2-3. Exact Solution of the Stability Equation of the Two-Axis Sampled-Data LST System by Numerical-Iterative Techniques

The numerical-iterative method described in Chapter 1 is now used to solve the stability equation of the two-axis sampled-data LST system, Eq. (2-26).

In Eq. (2-26) we define

$$\hat{G}_B(T,n) = G_{R1} + jG_{I1} \tag{2-28}$$

$$\hat{G}_C(T,n) = G_{R2} + jG_{I2} \tag{2-29}$$

$$N(A,n,\phi) = N_{R1} + jN_{I1} \tag{2-30}$$

$$N^2(A,n,\phi) = N_{R2} + jN_{I2} \tag{2-31}$$

where G_{R1}, G_{I1}, G_{R2}, G_{I2}, N_{R1}, N_{I1}, N_{R2}, and N_{I2} are all real quantities.

When Eqs. (2-28) through (2-31) are substituted into Eq. (2-26), and after grouping the real and imaginary parts, we have,

$$\Delta = \Delta_R + j\Delta_I = 0 \tag{2-32}$$

where

$$\Delta_R = 1 + G_{R1}N_{R1} - G_{I1}N_{I1} + G_{R2}N_{R2} - G_{I2}N_{I2} = 0 \tag{2-33}$$

$$\Delta_I = G_{I1}N_{R1} + G_{R1}N_{I1} + G_{I2}N_{R2} + G_{R2}N_{I2} = 0 \tag{2-34}$$

These two expressions represent two equations in four variables in A, T, ϕ, and n. It is necessary to assign values to two of these variables and solve for the remaining two using the numerical-iterative method. In general, it is practical to assign values to T and n, and Eqs. (2-33) and (2-34) are solved to yield A and ϕ. Alternatively, we may assign values to n and ϕ, and solve for A and T. The latter case has been carried out in the current study.

As in Chapter 1, we define

$$\underline{x} = \begin{Bmatrix} T \\ A \end{Bmatrix} \tag{2-35}$$

$$\underline{F} = \begin{Bmatrix} \Delta_R \\ \Delta_I \end{Bmatrix} \tag{2-36}$$

Then, Eqs. (2-33) and (2-34) can be written as

$$F(\underline{x}) = \underline{0} \tag{2-37}$$

The Newton-type quadratically convergent numerical method described in Chapter 1 can now be directly applied to this two-variable system.

The following system parameters are used:

$T_{GFO} = 0.1$ ft-lb

$H = 600$ ft-lb-sec

$J_G = 2.1$ ft-lb-sec^2

$K_o = 5758.35$

$K_1 = 1371.02$

$K_p = 216$ ft-lb/rad/sec

$K_I = 9700$ ft-lb/rad

$J_V = 10^5$ ft-lb-sec^2

$\gamma = 1.38 \times 10^7$

Three sets of coefficients of coupling are used for this study:

(1) $K_2 = 0.1$ $K_3 = 0.1$

(2) $K_2 = 1.0$ $K_3 = 0.1$

(3) $K_2 = 5.0$ $K_3 = 0.1$

For each integral n, and a fixed value of ϕ, a solution of Eq. (2-37) is attempted with an initial guess on T and A. A convergent solution for T and A together with the assigned n and ϕ describes a sustained oscillation in the system. One of the characteristics of the numerical method is that the solution depends on the initial conditions set by the analyst. As shown in the earlier studies, it is quite possible that a system may have a multiple number of solutions for the same set of n and ϕ. An exhaustive search can only be conducted by a systematic scan of all the possible combinations of the initial values in the iterative process, unless one has general information at the outset on the number and the proximity of the solutions.

Figure 2-4 shows the plots of the two solutions of T versus A for $K_2 = K_3 = 0.1$, and for relative large values of n. The results are shown only for $\phi = 0°$. When all the values of ϕ are used, the solutions of T and A trace out a loop in the T versus A domain. For large values of n, these loops are very small, as the solutions are relatively insensitive to n. As n decreases, these loops become more pronounced, as indicated in Fig. 2-5. As n decreases, one of the solutions disappears, as the amplitude of A becomes exceedingly small.

Figure 2-6 gives the computer results for $K_2 = K_3 = 0.1$ that correspond to one set of solutions for $\phi = 0°$. Figure 2-7 tabulates the other set of results for $K_2 = K_3 = 0.1$ with $\phi = 0°$. Figure 2-8 gives the tabulations of results for $K_2 = K_3 = 0.1$, n = 4, and variable ϕ.

Figures 2-9 and 2-10 give the results with $K_2 = 1.0$ and $K_3 = 0.1$. Figure 2-11 shows the solutions for $K_2 = 5.0$ and $K_3 = 0.1$ with $\phi = 0°$. In this case, the amplitude of oscillation decreases as n decreases, so that there is less chance for the low-frequency oscillations to occur.

The results indicate that harder coupling (larger values of K_2 and K_3) tends to reduce the chance of self-sustained oscillations.

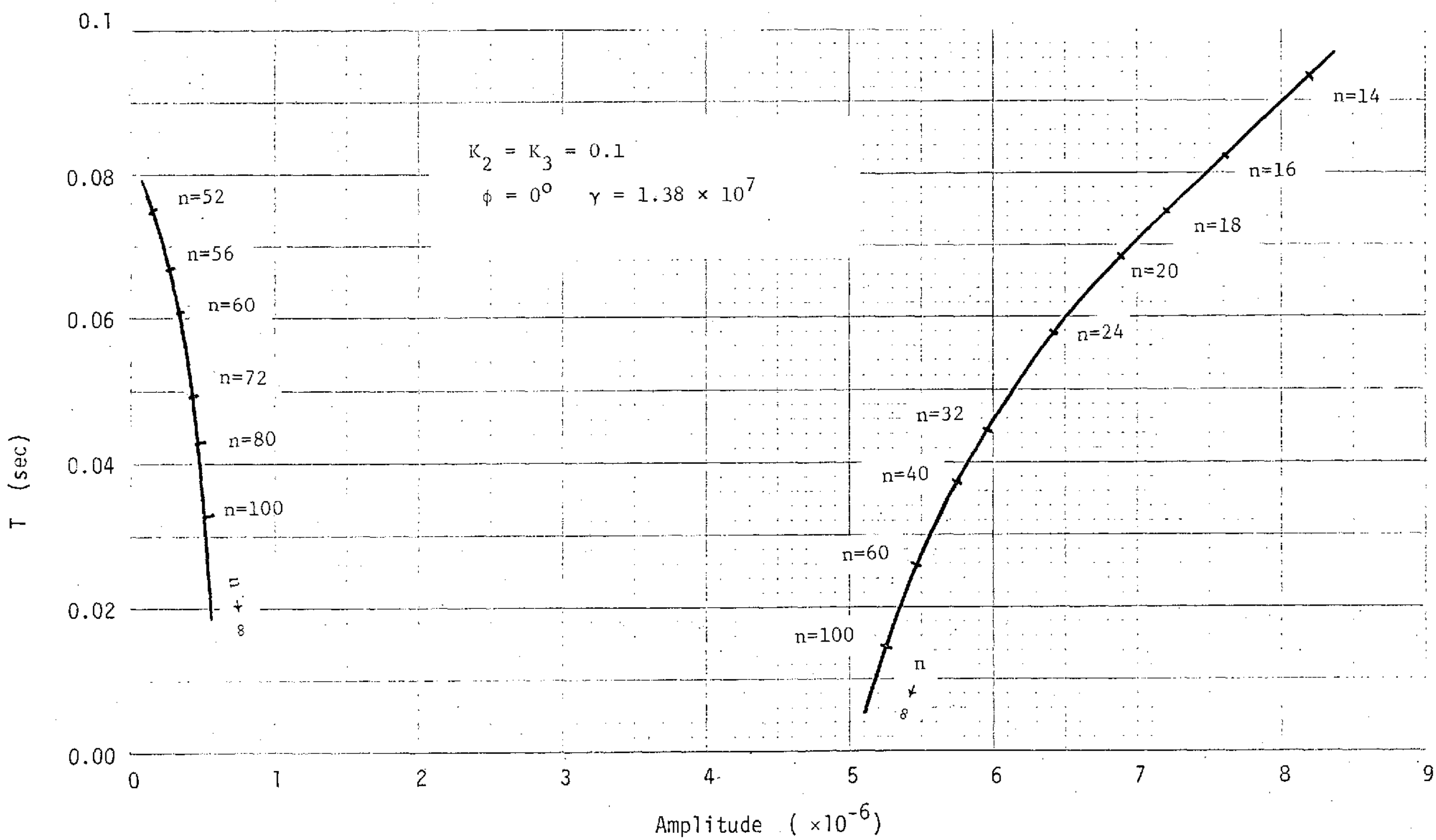


Figure 2-4. Amplitude and frequency ($2\pi/nT$) of self-sustained oscillations for various sampling periods in the discrete-data two-axis LST system; $\gamma = 1.38\times10^7$.

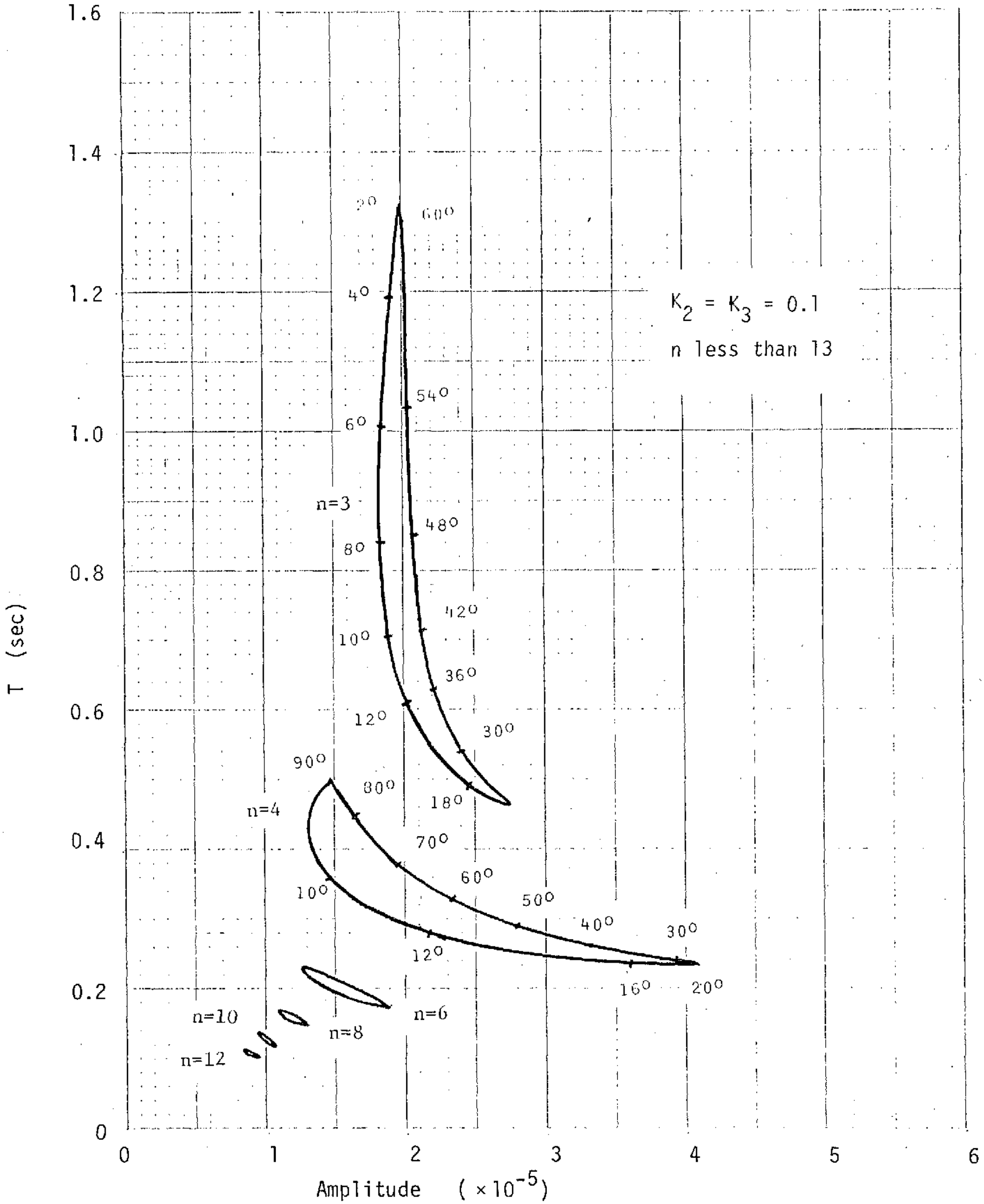


Figure 2-5. Amplitude and frequency ($2\pi/nT$) of self-sustained oscillations for various sampling periods in the discrete-data two-axis LST system; $\gamma = 1.38\times10^{7}$.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 100   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3320000000D-01	0.6000000000D-06
1	0.3342229250D-01	0.5950679807D-06
2	0.3359786023D-01	0.5747976449D-06
3	0.3366351585D-01	0.5668210713D-06
4	0.3369566512D-01	0.5625329043D-06
5	0.3369587215D-01	0.5627405691D-06
6	0.3369532634D-01	0.5435030290D-06
7	0.3364046622D-01	0.5571699439D-06
8	0.3367687123D-01	0.5598125454D-06
9	0.3369855892D-01	0.5609805886D-06
10	0.3366940604D-01	0.5629427540D-06
11	0.3369803223D-01	0.5630963918D-06

ND= 1   SAMPLING PERIOD= 3.36972D-02SEC   AMPLITUDE= 5.63342D-07   NT=11

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 96   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3369720849D-01	0.5633423550D-06
1	0.3474291538D-01	0.5443359999D-06
2	0.3502375402D-01	0.5470937221D-06
3	0.3511512195D-01	0.5512909117D-06
4	0.3515743963D-01	0.5536089799D-06
5	0.3518081455D-01	0.5546943617D-06
6	0.3515967466D-01	0.5562991873D-06
7	0.3518635462D-01	0.5566505449D-06

ND= 1   SAMPLING PERIOD= 3.51849D-02SEC   AMPLITUDE= 5.56679D-07   NT= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 92   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3518492122D-01	0.5566790381D-06
1	0.3632633789D-01	0.5366432487D-06
2	0.3663329016D-01	0.5393705578D-06
3	0.3673534759D-01	0.5435543568D-06
4	0.3678294190D-01	0.5458594565D-06
5	0.3680897407D-01	0.5469412658D-06
6	0.3675900402D-01	0.5494039884D-06
7	0.3679886044D-01	0.5492251820D-06
8	0.3680191726D-01	0.5613414977D-06
9	0.3686631866D-01	0.5506174407D-06
10	0.3684513633D-01	0.5495252589D-06
11	0.3683223886D-01	0.5491315696D-06
12	0.3698436993D-01	0.5346254689D-06
13	0.3691543458D-01	0.5378992242D-06
14	0.3684653330D-01	0.5439682800D-06
15	0.3672725204D-01	0.5512047322D-06

ND= 1   SAMPLING PERIOD= 3.67273D-02SEC   AMPLITUDE= 5.51205D-07   NT=15

Figure 2-6a.

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LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  88    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
      0      0.3672725204D-01      0.5512047322D-06
      1      0.3804951071D-01      0.5276558662D-06
      2      0.3840576574D-01      0.5297954747D-06
      3      0.3852469444D-01      0.5339405723D-06
      4      0.3858000219D-01      0.5362532059D-06
      5      0.3860978892D-01      0.5373461539D-06
      6      0.3880907639D-01      0.5325967023D-06
      7      0.3868869663D-01      0.5378718864D-06
      8      0.3862592890D-01      0.5407750867D-06
      9      0.3864946584D-01      0.5376668762D-06
     10      0.3865443397D-01      0.5369972470D-06
     11      0.3865827663D-01      0.5367328089D-06

ND= 1    SAMPLING PERIOD= 3.86637D-02SEC    AMPLITUDE= 5.36429D-07    NT=11

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  84    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
      0      0.3866366421D-01      0.5364285381D-06
      1      0.4002364976D-01      0.5150849745D-06
      2      0.4039100134D-01      0.5180707747D-06
      3      0.4052223920D-01      0.5221609257D-06
      4      0.4058490375D-01      0.5243717423D-06
      5      0.4061860445D-01      0.5254083819D-06
      6      0.4071084231D-01      0.5239274439D-06
      7      0.4059663023D-01      0.5309992476D-06
      8      0.4063733861D-01      0.5264303961D-06
      9      0.4063732542D-01      0.5264214375D-06

ND= 1    SAMPLING PERIOD= 4.06373D-02SEC    AMPLITUDE= 5.26414D-07    NT= 9

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  80    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
      0      0.4063731418D-01      0.5264143904D-06
      1      0.4219079242D-01      0.5014704472D-06
      2      0.4261349518D-01      0.5035421161D-06
      3      0.4276607502D-01      0.5073101923D-06
      4      0.4283895084D-01      0.5093689227D-06
      5      0.4287790411D-01      0.5103291743D-06
      6      0.4294168292D-01      0.5097411227D-06
      7      0.4295739576D-01      0.5084227662D-06
      8      0.4299599510D-01      0.5061352377D-06
      9      0.4293833241D-01      0.5120656117D-06
     10      0.4289974529D-01      0.5131564094D-06
     11      0.4297234920D-01      0.5063036490D-06
     12      0.4212358522D-01      0.5310503269D-06
     13      0.4259046767D-01      0.5186986412D-06
     14      0.4277253918D-01      0.5147065691D-06
     15      0.4284118828D-01      0.5137414959D-06

ND= 1    SAMPLING PERIOD= 4.28412D-02SEC    AMPLITUDE= 5.13741D-07    NT=15
```

Figure 2-6b.

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LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  76    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
        0      0.4284118828D-01     0.5137414959D-06
        1      0.4464118167D-01     0.4841942659D-06
        2      0.4513404690D-01     0.4850800623D-06
        3      0.4531456953D-01     0.4883825027D-06
        4      0.4540097269D-01     0.4902121173D-06
        5      0.4544690240D-01     0.4910561502D-06
        6      0.4550158575D-01     0.4908031820D-06
        7      0.4550362167D-01     0.4906108580D-06

ND= 1    SAMPLING PERIOD= 4.55056D-02SEC    AMPLITUDE= 4.90508D-07    NT= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  72    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
        0      0.4550564878D-01     0.4905077202D-06
        1      0.4748492582D-01     0.4602676060D-06
        2      0.4803270735D-01     0.4611052828D-06
        3      0.4824690167D-01     0.4639223444D-06
        4      0.4835158441D-01     0.4654279102D-06
        5      0.4840710028D-01     0.4661008946D-06
        6      0.4845886027D-01     0.4660126242D-06
        7      0.4845913823D-01     0.4659959617D-06

ND= 1    SAMPLING PERIOD= 4.84594D-02SEC    AMPLITUDE= 4.65983D-07    NT= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  68    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
        0      0.4845942328D-01     0.4659832194D-06
        1      0.5077128819D-01     0.4305541220D-06
        2      0.5141496277D-01     0.4300316467D-06
        3      0.5167697185D-01     0.4319612733D-06
        4      0.5180659395D-01     0.4329628233D-06
        5      0.5187519910D-01     0.4333733303D-06
        6      0.5192792338D-01     0.4333555693D-06
        7      0.5192794877D-01     0.4333381285D-06

ND= 1    SAMPLING PERIOD= 5.19280D-02SEC    AMPLITUDE= 4.33328D-07    NT= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=  64    PHI= 0.0
  ITERATION  SAMPLING PERIOD         AMPLITUDE
        0      0.5192797142D-01     0.4333278588D-06
        1      0.5467724495D-01     0.3910672890D-06
        2      0.5544071603D-01     0.3889380378D-06
        3      0.5576780112D-01     0.3896501958D-06
        4      0.5593237218D-01     0.3899343046D-06
        5      0.5601946040D-01     0.3899684217D-06
        6      0.5607441769D-01     0.3899899126D-06

ND= 1    SAMPLING PERIOD= 5.60744D-02SEC    AMPLITUDE= 3.90010D-07    NT= 6
```

Figure 2-6c.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 60 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.5607440724D-01	0.3900104301D-06
1	0.5943855184D-01	0.3377628184D-06
2	0.6034357899D-01	0.3340925505D-06
3	0.6075649615D-01	0.3332972694D-06
4	0.6096880899D-01	0.3326451744D-06
5	0.6108148602D-01	0.3321774347D-06
6	0.6113998602D-01	0.3321931013D-06
7	0.6113993477D-01	0.3289034850D-06
8	0.6109176163D-01	0.3321856964D-06
9	0.6113616294D-01	0.3324425205D-06
10	0.6113606465D-01	0.3377813726D-06
11	0.6120186225D-01	0.3313524294D-06
12	0.6120897519D-01	0.3301622286D-06
13	0.6121337436D-01	0.3297677155D-06
14	0.6121811619D-01	0.3295921224D-06

ND= 1 SAMPLING PERIOD= 6.12248D-02SEC AMPLITUDE= 3.29551D-07 NT=14

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 56 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6122479469D-01	0.3293509878D-06
1	0.6543301761D-01	0.2639577502D-06
2	0.6645173242D-01	0.2608253382D-06
3	0.6695797940D-01	0.2589494244D-06
4	0.6722604406D-01	0.2574374605D-06
5	0.6737019848D-01	0.2564397595D-06
6	0.6743896903D-01	0.2562879806D-06
7	0.6743928847D-01	0.2557157062D-06
8	0.6744092888D-01	0.2559094333D-06

ND= 1 SAMPLING PERIOD= 6.74417D-02SEC AMPLITUDE= 2.55843D-07 NT= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 52 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6744166977D-01	0.2558430579D-06
1	0.7328507727D-01	0.1592166005D-06
2	0.7518829983D-01	0.1180376352D-06
3	0.7544197006D-01	0.1414855224D-06
4	0.7548893187D-01	0.1539881111D-06
5	0.7540087284D-01	0.1577965747D-06
6	0.7534052323D-01	0.1600971463D-06
7	0.7534675854D-01	0.1589113884D-06
8	0.7656361713D-01	0.1052268639D-06
9	0.7609634676D-01	0.1297537881D-06
10	0.7572642564D-01	0.1448123696D-06
11	0.7551859241D-01	0.1531497593D-06
12	0.7541613162D-01	0.1573705387D-06
13	0.7535353854D-01	0.1597008993D-06
14	0.7537343098D-01	0.1579027493D-06
15	0.7533086135D-01	0.1600055409D-06

ND= 1 SAMPLING PERIOD= 7.53309D-02SEC AMPLITUDE= 1.60006D-07 NT=15

Figure 2-6d.

```
LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07    N= 100    PHI= 0.0
  ITERATION  SAMPLING PERIOD        AMPLITUDE
       0     0.1530000000D-01     0.5000000000D-05
       1     0.1518129565D-01     0.5123194566D-05
       2     0.1512363339D-01     0.5186988252D-05
       3     0.1509538498D-01     0.5218608809D-05
       4     0.1507480998D-01     0.5240422024D-05
       5     0.1507577419D-01     0.5231844048D-05
       6     0.1508043353D-01     0.5225764830D-05
       7     0.1505980197D-01     0.5253128272D-05
       8     0.1505978776D-01     0.5253562257D-05

ND= 1   SAMPLING PERIOD= 1.50598D-02SEC   AMPLITUDE= 5.25387D-06   N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07    N=  96    PHI= 0.0
  ITERATION  SAMPLING PERIOD        AMPLITUDE
       0     0.1505977177D-01     0.5253865498D-05
       1     0.1524686473D-01     0.5424210948D-05
       2     0.1545679048D-01     0.5350687791D-05
       3     0.1556856306D-01     0.5306547099D-05
       4     0.1562697461D-01     0.5282550091D-05
       5     0.1565694849D-01     0.5270912439D-05
       6     0.1566106863D-01     0.5268612074D-05

ND= 1   SAMPLING PERIOD= 1.56629D-02SEC   AMPLITUDE= 5.26612D-06   N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= K3=0.1
GAMMA= 1.38000D 07    N=  92    PHI= 0.0
  ITERATION  SAMPLING PERIOD        AMPLITUDE
       0     0.1566289858D-01     0.5266116798D-05
       1     0.1586928307D-01     0.5447574799D-05
       2     0.1610269510D-01     0.5367998314D-05
       3     0.1622686675D-01     0.5320407881D-05
       4     0.1629157791D-01     0.5294671135D-05
       5     0.1632500326D-01     0.5281905680D-05
       6     0.1633084641D-01     0.5279681922D-05

ND= 1   SAMPLING PERIOD= 1.63327D-02SEC   AMPLITUDE= 5.27664D-06   N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= K3=0.1
GAMMA= 1.38000D 07    N=  88    PHI= 0.0
  ITERATION  SAMPLING PERIOD        AMPLITUDE
       0     0.1633272606D-01     0.5276636683D-05
       1     0.1655487224D-01     0.5469159244D-05
       2     0.1681022992D-01     0.5384743931D-05
       3     0.1694596034D-01     0.5334456511D-05
       4     0.1701655283D-01     0.5307374841D-05
       5     0.1705310040D-01     0.5293798727D-05
       6     0.1706059616D-01     0.5291479667D-05

ND= 1   SAMPLING PERIOD= 1.70625D-02SEC   AMPLITUDE= 5.28804D-06   N= 6
```

Figure 2-7a.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 84 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1706249398D-01	0.5288035305D-05
1	0.1730216910D-01	0.5492965186D-05
2	0.1758264220D-01	0.5403218271D-05
3	0.1773159629D-01	0.5349960075D-05
4	0.1780891451D-01	0.5321397585D-05
5	0.1784898970D-01	0.5306963522D-05
6	0.1785857215D-01	0.5304398319D-05

ND= 1 SAMPLING PERIOD= 1.78605D-02SEC AMPLITUDE= 5.30055D-06 N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 80 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1786045844D-01	0.5300553416D-05
1	0.1811982227D-01	0.5519351613D-05
2	0.1842922889D-01	0.5423709952D-05
3	0.1859341236D-01	0.5367165464D-05
4	0.1867847392D-01	0.5336964779D-05
5	0.1872256983D-01	0.5321613915D-05
6	0.1873473958D-01	0.5318625613D-05

ND= 1 SAMPLING PERIOD= 1.87366D-02SEC AMPLITUDE= 5.31440D-06 N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 76 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1873659666D-01	0.5314404685D-05
1	0.1901820814D-01	0.5548749727D-05
2	0.1936116657D-01	0.5446568116D-05
3	0.1954300378D-01	0.5386375032D-05
4	0.1963703870D-01	0.5354355062D-05
5	0.1968575521D-01	0.5338016228D-05
6	0.1970106583D-01	0.5334412132D-05

ND= 1 SAMPLING PERIOD= 1.97029D-02SEC AMPLITUDE= 5.32987D-06 N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 72 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1970289817D-01	0.5329874321D-05
1	0.2000983375D-01	0.5581692582D-05
2	0.2039198082D-01	0.5472228691D-05
3	0.2059442799D-01	0.5407968980D-05
4	0.2069893590D-01	0.5373920400D-05
5	0.2075300819D-01	0.5356507849D-05
6	0.2077205288D-01	0.5352094185D-05

ND= 1 SAMPLING PERIOD= 2.07739D-02SEC AMPLITUDE= 5.34734D-06 N= 6

Figure 2-7b.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 68 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2077389646D-01	0.5347338290D-05
1	0.2110990716D-01	0.5618848722D-05
2	0.2153819175D-01	0.5501243897D-05
3	0.2176488804D-01	0.5432432679D-05
4	0.2188171440D-01	0.5396112375D-05
5	0.2194205081D-01	0.5377523077D-05
6	0.2196545462D-01	0.5372120519D-05
7	0.2196738711D-01	0.5367283776D-05

ND= 1 SAMPLING PERIOD= 2.19698D-02SEC AMPLITUDE= 5.36633D-06 N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 64 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2196979444D-01	0.5366325166D-05
1	0.2233797565D-01	0.5660864357D-05
2	0.2282065817D-01	0.5534189623D-05
3	0.2307590015D-01	0.5460323816D-05
4	0.2320721900D-01	0.5421483097D-05
5	0.2327489029D-01	0.5401612738D-05
6	0.2330325793D-01	0.5395087322D-05
7	0.2330541216D-01	0.5390331951D-05

ND= 1 SAMPLING PERIOD= 2.33080D-02SEC AMPLITUDE= 5.38932D-06 N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 60 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2330800876D-01	0.5389317022D-05
1	0.2371546467D-01	0.5709270125D-05
2	0.2426386869D-01	0.5572273900D-05
3	0.2455357389D-01	0.5492624723D-05
4	0.2470238392D-01	0.5450894726D-05
5	0.2477887551D-01	0.5429575152D-05
6	0.2481300177D-01	0.5421785319D-05
7	0.2481560381D-01	0.5417289555D-05

ND= 1 SAMPLING PERIOD= 2.48185D-02SEC AMPLITUDE= 5.41611D-06 N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2=K3=0.1
GAMMA= 1.38000D 07 N= 56 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2481845775D-01	0.5416109190D-05
1	0.2527222590D-01	0.5765341923D-05
2	0.2590037116D-01	0.5616616810D-05
3	0.2623180446D-01	0.5530395043D-05
4	0.2640177621D-01	0.5485381470D-05
5	0.2648890472D-01	0.5462434531D-05
6	0.2652964524D-01	0.5453286148D-05
7	0.2653307741D-01	0.5449211264D-05

ND= 1 SAMPLING PERIOD= 2.65363D-02SEC AMPLITUDE= 5.44773D-06 N= 7

Figure 2-7c.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= K3=0.1
GAMMA= 1.38000D 07   N= 52   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2653626294D-01	0.5447726057D-05
1	0.2704516365D-01	0.5831066474D-05
2	0.2777126829D-01	0.5668929305D-05
3	0.2815380132D-01	0.5575201503D-05
4	0.2834965647D-01	0.5526440168D-05
5	0.2844975878D-01	0.5501653871D-05
6	0.2849817152D-01	0.5491072646D-05
7	0.2850309567D-01	0.5487526844D-05

ND= 1   SAMPLING PERIOD= 2.85067D-02SEC   AMPLITUDE= 5.48557D-06   N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= K3=0.1
GAMMA= 1.38000D 07   N= 48   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2850665382D-01	0.5485568768D-05
1	0.2908182190D-01	0.5909195409D-05
2	0.2992997663D-01	0.5731615644D-05
3	0.3037586916D-01	0.5629278377D-05
4	0.3060375828D-01	0.5576224764D-05
5	0.3071987517D-01	0.5549348977D-05
6	0.3077733074D-01	0.5537268220D-05
7	0.3078489658D-01	0.5534252531D-05

ND= 1   SAMPLING PERIOD= 3.07888D-02SEC   AMPLITUDE= 5.53163D-06   N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= K3=0.1
GAMMA= 1.38000D 07   N= 44   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3078877141D-01	0.5531631338D-05
1	0.3144439053D-01	0.6003648010D-05
2	0.3244709861D-01	0.5808155804D-05
3	0.3297263070D-01	0.5695914173D-05
4	0.3324066935D-01	0.5637937052D-05
5	0.3337680368D-01	0.5608681697D-05
6	0.3344512981D-01	0.5595031020D-05
7	0.3345727029D-01	0.5592361838D-05

ND= 1   SAMPLING PERIOD= 3.34613D-02SEC   AMPLITUDE= 5.58889D-06   N= 7

Figure 2-7d.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 20 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6000000000D-01	0.1000000000D-04
1	0.6480879984D-01	0.7617629854D-05
2	0.6678026019D-01	0.7172493189D-05
3	0.6769282120D-01	0.6996822188D-05
4	0.6813043341D-01	0.6918483150D-05
5	0.6834250429D-01	0.6882531139D-05
6	0.6843089594D-01	0.6868190612D-05
7	0.6844645543D-01	0.6858162908D-05
8	0.6846072173D-01	0.6854744930D-05

ND= 1 SAMPLING PERIOD= 6.84679D-02SEC AMPLITUDE= 6.65169D-06 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 24 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6846787904D-01	0.6851692663D-05
1	0.6789688908D-01	0.3849797353D-05
2	0.6337381658D-01	0.4653644434D-05
3	0.5831592193D-01	0.5118555517D-05
4	0.5725147888D-01	0.6136508163D-05
5	0.5736972579D-01	0.6487885453D-05
6	0.5792383375D-01	0.6435598888D-05
7	0.5820889924D-01	0.6406344572D-05
8	0.5835654751D-01	0.6390808096D-05
9	0.5842629652D-01	0.6385681095D-05
10	0.5842870822D-01	0.6381238265D-05

ND= 1 SAMPLING PERIOD= 5.84322D-02SEC AMPLITUDE= 6.38106D-06 N=10

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 28 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.5843215529D-01	0.6381063121D-05
1	0.5820296047D-01	0.4079361184D-05
2	0.5508804677D-01	0.4770388789D-05
3	0.5318242804D-01	0.5298937351D-05
4	0.5210219143D-01	0.5650467227D-05
5	0.5152852903D-01	0.5858912969D-05
6	0.5124344808D-01	0.5972604748D-05
7	0.5111741517D-01	0.6030052909D-05
8	0.5106046578D-01	0.6056801388D-05
9	0.5095802379D-01	0.6100937101D-05
10	0.5095684164D-01	0.6038873942D-05
11	0.5095120443D-01	0.6074084692D-05
12	0.5096937825D-01	0.6080501700D-05
13	0.5096940058D-01	0.6077955158D-05

ND= 1 SAMPLING PERIOD= 5.09695D-02SEC AMPLITUDE= 6.07877D-06 N=13

Figure 2-7e.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 32 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.5096945201D-01	0.6078770868D-05
1	0.5102497922D-01	0.4119164140D-05
2	0.4843472824D-01	0.4757019016D-05
3	0.4689683602D-01	0.5226284689D-05
4	0.4604573283D-01	0.5527945186D-05
5	0.4560202105D-01	0.5702210947D-05
6	0.4538356113D-01	0.5795155652D-05
7	0.4527921299D-01	0.5841551842D-05
8	0.4521944665D-01	0.5866212585D-05
9	0.4547300879D-01	0.5727916838D-05
10	0.4526315608D-01	0.5814044194D-05
11	0.4537422954D-01	0.5854147556D-05
12	0.4524681043D-01	0.5881198353D-05
13	0.4564413164D-01	0.5608709870D-05
14	0.4633465363D-01	0.5827421616D-05
15	0.4573028770D-01	0.5870448911D-05
16	0.4545788829D-01	0.5873782757D-05
17	0.4530423077D-01	0.5883699879D-05
18	0.4519352759D-01	0.5908390757D-05
19	0.4518646046D-01	0.5885245069D-05
20	0.4518756513D-01	0.5872280096D-05

ND= 1 SAMPLING PERIOD= 4.51876D-02SEC AMPLITUDE= 5.87228D-06 N=20

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 36 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.4518756513D-01	0.5872280096D-05
1	0.4548441205D-01	0.4079529734D-05
2	0.4319492135D-01	0.4704818647D-05
3	0.4187535337D-01	0.5152752542D-05
4	0.4116129664D-01	0.5438852030D-05
5	0.4079400964D-01	0.5593423376D-05
6	0.4061516882D-01	0.5678091430D-05
7	0.4054580647D-01	0.5719556013D-05
8	0.4051715401D-01	0.5738437457D-05
9	0.4052024514D-01	0.5733467174D-05

ND= 1 SAMPLING PERIOD= 4.05284D-02SEC AMPLITUDE= 5.72936D-06 N= 9

Figure 2-7f.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 40 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.4052841794D-01	0.5729359139D-05
1	0.4105375766D-01	0.3998945099D-05
2	0.3886407364D-01	0.4642514785D-05
3	0.3754964350D-01	0.5096797069D-05
4	0.3794399220D-01	0.5485304103D-05
5	0.3726602911D-01	0.5596246507D-05
6	0.3696647229D-01	0.5629638876D-05
7	0.3681466579D-01	0.5646601267D-05
8	0.3671742546D-01	0.5669053607D-05
9	0.3671836255D-01	0.5637763821D-05
10	0.3674581125D-01	0.5613664939D-05
11	0.3671290779D-01	0.5635281029D-05
12	0.3674022718D-01	0.5616052818D-05
13	0.3670940690D-01	0.5636684469D-05
14	0.3672410413D-01	0.5624874991D-05
15	0.3669172621D-01	0.5645132778D-05
16	0.3669257664D-01	0.5640180348D-05

ND= 1 SAMPLING PERIOD= 3.66940D-02SEC AMPLITUDE= 5.63892D-06 N=16

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 44 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3669404019D-01	0.5638919976D-05
1	0.3740138530D-01	0.3908915533D-05
2	0.3491010532D-01	0.4588934634D-05
3	0.3481136753D-01	0.5336708821D-05
4	0.3411195900D-01	0.5483498604D-05
5	0.3379425697D-01	0.5541220300D-05
6	0.3363829381D-01	0.5568211972D-05
7	0.3354367470D-01	0.5593421704D-05
8	0.3354678742D-01	0.5560533574D-05
9	0.3369878931D-01	0.5457110214D-05
10	0.3358042361D-01	0.5524775541D-05
11	0.3354143435D-01	0.5555863009D-05
12	0.3348766736D-01	0.5589398120D-05
13	0.3348753557D-01	0.5678668056D-05
14	0.3352719081D-01	0.5526348349D-05
15	0.3352337686D-01	0.5596966864D-05
16	0.3352119786D-01	0.5575070099D-05
17	0.3352224713D-01	0.5566019732D-05
18	0.3352487997D-01	0.5563343263D-05

ND= 1 SAMPLING PERIOD= 3.35304D-02SEC AMPLITUDE= 5.56041D-06 N=18

Figure 2-7g.

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LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 20 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6000000000D-01	0.1000000000D-04
1	0.6480879984D-01	0.7617629854D-05
2	0.6678026019D-01	0.7172493189D-05
3	0.6769282120D-01	0.6996822188D-05
4	0.6813043341D-01	0.6918483150D-05
5	0.6834250429D-01	0.6882531139D-05
6	0.6843089594D-01	0.6868190612D-05
7	0.6844645543D-01	0.6858162908D-05
8	0.6846072173D-01	0.6854744930D-05

ND= 1 SAMPLING PERIOD= 6.84679D-02SEC AMPLITUDE= 6.85169D-06 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 18 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6846787904D-01	0.6851692663D-05
1	0.7043256707D-01	0.7494237996D-05
2	0.7274274026D-01	0.7358573278D-05
3	0.7391256151D-01	0.7270807448D-05
4	0.7449677609D-01	0.7224620222D-05
5	0.7478967216D-01	0.7201219589D-05
6	0.7494095861D-01	0.7189269556D-05
7	0.7500155196D-01	0.7187936355D-05

ND= 1 SAMPLING PERIOD= 7.50031D-02SEC AMPLITUDE= 7.18146D-06 N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 16 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.7500313876D-01	0.7181455222D-05
1	0.7757207225D-01	0.7904102565D-05
2	0.8036526528D-01	0.7783556832D-05
3	0.8177101684D-01	0.7699329912D-05
4	0.8247175785D-01	0.7654031462D-05
5	0.8282203857D-01	0.7631003421D-05
6	0.8300181793D-01	0.7619062586D-05
7	0.8309100145D-01	0.7615679741D-05
8	0.8309249707D-01	0.7610629302D-05

ND= 1 SAMPLING PERIOD= 8.30950D-02SEC AMPLITUDE= 7.61094D-06 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 14 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.8309501073D-01	0.7610937609D-05
1	0.8671839029D-01	0.8403642551D-05
2	0.9017647994D-01	0.8318391106D-05
3	0.9190691383D-01	0.8246307498D-05
4	0.9276881881D-01	0.8205510559D-05
5	0.9319861204D-01	0.8184558899D-05
6	0.9341750696D-01	0.8173588624D-05
7	0.9353498942D-01	0.8168723849D-05
8	0.9353941607D-01	0.8167792823D-05

ND= 1 SAMPLING PERIOD= 9.35426D-02SEC AMPLITUDE= 8.16689D-06 N= 8

Figure 2-7h.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 12 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.9354264774D-01	0.8166885799D-05
1	0.9916118222D-01	0.8990156255D-05
2	0.1035439723D 00	0.8984162026D-05
3	0.1057325363D 00	0.8944119276D-05
4	0.1060237479D 00	0.8916749965D-05
5	0.1073660119D 00	0.8902207034D-05
6	0.1076409935D 00	0.8894513616D-05
7	0.1077889937D 00	0.8890091772D-05
8	0.1078160524D 00	0.8894539016D-05

ND= 1 SAMPLING PERIOD= 1.07818D-01SEC AMPLITUDE= 8.88944D-06 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 10 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1078178113D 00	0.8889444839D-05
1	0.1177100597D 00	0.9621415477D-05
2	0.1232336219D 00	0.9801365517D-05
3	0.1260503243D 00	0.9840692922D-05
4	0.1274639680D 00	0.9849211926D-05
5	0.1281670380D 00	0.9852245354D-05
6	0.1285188980D 00	0.9853611699D-05
7	0.1287044745D 00	0.9853366902D-05
8	0.1288196333D 00	0.9855235553D-05

ND= 1 SAMPLING PERIOD= 1.28820D-01SEC AMPLITUDE= 9.85437D-06 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 8 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1288195875D 00	0.9854365774D-05
1	0.1497371337D 00	0.1019829650D-04
2	0.1558208532D 00	0.1080467416D-04
3	0.1593738457D 00	0.1102825825D-04
4	0.1612007188D 00	0.1112635578D-04
5	0.1621135626D 00	0.1117426051D-04
6	0.1625677190D 00	0.1119856757D-04
7	0.1628001760D 00	0.1121022683D-04
8	0.1629475305D 00	0.1121329115D-04

ND= 1 SAMPLING PERIOD= 1.62948D-01SEC AMPLITUDE= 1.12223D-05 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE K2=K3=0.1
GAMMA= 1.38000D 07 N= 6 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1629483722D 00	0.1122229409D-04
1	0.2218967506D 00	0.1065971960D-04
2	0.2236741739D 00	0.1198790559D-04
3	0.2275103182D 00	0.1256521127D-04
4	0.2295949249D 00	0.1226281146D-04
5	0.2306573515D 00	0.1301572755D-04
6	0.2311896028D 00	0.1309374339D-04
7	0.2314570519D 00	0.1313313639D-04
8	0.2315967783D 00	0.1315256779D-04
9	0.2317193751D 00	0.1315821728D-04

ND= 1 SAMPLING PERIOD= 2.31695D-01SEC AMPLITUDE= 1.31578D-05 N= 9

Figure 2-7i.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 19   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.6900000000D-01	0.6850000000D-05
1	0.6982002868D-01	0.7104879786D-05
2	0.7067198796D-01	0.7062188727D-05
3	0.7111813172D-01	0.7032306300D-05
4	0.7134776361D-01	0.7015467044D-05
5	0.7146958603D-01	0.7006501293D-05
6	0.7149620972D-01	0.7007741175D-05

ND= 1   SAMPLING PERIOD= 7.14990D-02SEC   AMPLITUDE= 7.00315D-06   N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 17   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.7149897424D-01	0.7003148764D-05
1	0.7359621221D-01	0.7702531492D-05
2	0.7613679043D-01	0.7565776232D-05
3	0.7741360351D-01	0.7477910174D-05
4	0.7804933352D-01	0.7431759498D-05
5	0.7836715321D-01	0.7408489682D-05
6	0.7853062384D-01	0.7396573734D-05
7	0.7860385230D-01	0.7394488910D-05

ND= 1   SAMPLING PERIOD= 7.86051D-02SEC   AMPLITUDE= 7.38821D-06   N= 7

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 15   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.7860513935D-01	0.7388205125D-05
1	0.8131859728D-01	0.8191990949D-05
2	0.8442897636D-01	0.8070950868D-05
3	0.8598065958D-01	0.7987256391D-05
4	0.8675165745D-01	0.7942301507D-05
5	0.8713578826D-01	0.7919630257D-05
6	0.8733187734D-01	0.7907942364D-05
7	0.8743345623D-01	0.7903856553D-05
8	0.8743538238D-01	0.7900274883D-05

ND= 1   SAMPLING PERIOD= 8.74380D-02SEC   AMPLITUDE= 7.90034D-06   N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07   N= 13   PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.8743796585D-01	0.7900338702D-05
1	0.9117515478D-01	0.8823611040D-05
2	0.9508524084D-01	0.8739792180D-05
3	0.9702350587D-01	0.8668990230D-05
4	0.9798596860D-01	0.8628730973D-05
5	0.9846407971D-01	0.8608334827D-05
6	0.9870591642D-01	0.8597856687D-05
7	0.9883613977D-01	0.8592761851D-05
8	0.9884468557D-01	0.8594229618D-05

ND= 1   SAMPLING PERIOD= 9.88479D-02SEC   AMPLITUDE= 8.59222D-06   N= 8

Figure 2-7j.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 11 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.9884794368D-01	0.8592219278D-05
1	0.1044747499D 00	0.9640300450D-05
2	0.1095187279D 00	0.9645574868D-05
3	0.1120148145D 00	0.9609851254D-05
4	0.1132569073D 00	0.9583728478D-05
5	0.1138726419D 00	0.9570155354D-05
6	0.1141811415D 00	0.9563325304D-05
7	0.1143452988D 00	0.9559276510D-05
8	0.1143988886D 00	0.9564527102D-05
9	0.1143991287D 00	0.9554879230D-05
10	0.1144006480D 00	0.9558310577D-05

ND= 1 SAMPLING PERIOD= 1.14401D-01SEC AMPLITUDE= 9.55743D-06 N=10

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 9 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1144013081D 00	0.9557425297D-05
1	0.1241494017D 00	0.1067754392D-04
2	0.1306587769D 00	0.1091301385D-04
3	0.1339507820D 00	0.1097420956D-04
4	0.1356040142D 00	0.1099044938D-04
5	0.1364238133D 00	0.1099746791D-04
6	0.1368311416D 00	0.1100135561D-04
7	0.1370419319D 00	0.1100264376D-04
8	0.1371781879D 00	0.1100269404D-04

ND= 1 SAMPLING PERIOD= 1.37178D-01SEC AMPLITUDE= 1.10042D-05 N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 7 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1371781828D 00	0.1100419929D-04
1	0.1588942126D 00	0.1188690438D-04
2	0.1661359636D 00	0.1274324753D-04
3	0.1704188526D 00	0.1307466534D-04
4	0.1726362836D 00	0.1322051006D-04
5	0.1737443075D 00	0.1329200577D-04
6	0.1742927971D 00	0.1332879126D-04
7	0.1745694438D 00	0.1334713151D-04
8	0.1747289928D 00	0.1335402056D-04
9	0.1745581227D 00	0.1337072875D-04
10	0.1747405965D 00	0.1336926525D-04
11	0.1747407951D 00	0.1336251723D-04

ND= 1 SAMPLING PERIOD= 1.74742D-01SEC AMPLITUDE= 1.33682D-05 N=11

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 5 PHI= 0.0

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.1747423365D 00	0.1336817555D-04
1	0.2495296658D 00	0.1275924454D-04
2	0.2467069249D 00	0.1494332451D-04
3	0.2510819205D 00	0.1595232873D-04
4	0.2535581725D 00	0.1649747219D-04
5	0.2548456164D 00	0.1678316421D-04
6	0.2554959218D 00	0.1693025549D-04
7	0.2558226254D 00	0.1700500828D-04
8	0.2559894316D 00	0.1704250683D-04
9	0.2560881662D 00	0.1706015366D-04
10	0.2560833384D 00	0.1707718967D-04

ND= 1 SAMPLING PERIOD= 2.56084D-01SEC AMPLITUDE= 1.70779D-05 N=10

Figure 2-7k.

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LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=    4    PHI= 9.00000D 01
  ITERATION  SAMPLING PERIOD        AMPLITUDE
        0      0.5000000000D 00     0.1500000000D-04
        1      0.5154240480D 00     0.1377904361D-04
        2      0.5395948070D 00     0.1446567295D-04
        3      0.5480038734D 00     0.1474781509D-04
        4      0.5501232936D 00     0.1486946298D-04
        5      0.5498353305D 00     0.1493377898D-04
        6      0.5496153256D 00     0.1496763755D-04
        7      0.5495519111D 00     0.1498535914D-04
        8      0.5495572657D 00     0.1498126090D-04

ND= 1    SAMPLING PERIOD= 5.49637D-01SEC    AMPLITUDE= 1.49913D-05    N= 8

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=    4    PHI= 8.00000D 01
  ITERATION  SAMPLING PERIOD        AMPLITUDE
        0      0.5496365534D 00     0.1499127478D-04
  2     5.49637D-01    -1.91174D-05
  2     5.50186D-01    -1.95688D-05
        1      0.4234186796D 00     0.8454562303D-04
  2     4.23419D-01    -7.38180D-05
  2     4.23842D-01    -7.45811D-05
        2      0.3730698891D 00     0.1692422145D-04
        3      0.4128434144D 00     0.1637625694D-04
        4      0.4312546179D 00     0.1654907656D-04
        5      0.4397401524D 00     0.1665122919D-04
        6      0.4438301096D 00     0.1670404294D-04
        7      0.4458433195D 00     0.1673064847D-04
        8      0.4468524793D 00     0.1674390833D-04
        9      0.4473906822D 00     0.1675010719D-04
       10      0.4475205608D 00     0.1675157026D-04

ND= 1    SAMPLING PERIOD= 4.47512D-01SEC    AMPLITUDE= 1.67488D-05    N=10

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07    N=    4    PHI= 7.00000D 01
  ITERATION  SAMPLING PERIOD        AMPLITUDE
        0      0.4475120178D 00     0.1674881540D-04
        1      0.4216082457D 00     0.1861170429D-04
        2      0.4051047902D 00     0.1900082144D-04
        3      0.3938394079D 00     0.1918318637D-04
        4      0.3867604154D 00     0.1928180740D-04
        5      0.3825407502D 00     0.1933525459D-04
        6      0.3801177764D 00     0.1936336477D-04
        7      0.3787622054D 00     0.1937772905D-04
        8      0.3780160288D 00     0.1938492295D-04
        9      0.3776076550D 00     0.1938848190D-04
       10      0.3773823844D 00     0.1939023413D-04

ND= 1    SAMPLING PERIOD= 3.77255D-01SEC    AMPLITUDE= 1.93911D-05    N=10
```

Figure 2-8a.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 6.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3772549942D 00	0.1939110275D-04
1	0.3599882449D 00	0.2122313759D-04
2	0.3474431151D 00	0.2199493076D-04
3	0.3389745293D 00	0.2246394718D-04
4	0.3336445753D 00	0.2275171224D-04
5	0.3304527295D 00	0.2292115436D-04
6	0.3286099425D 00	0.2301675458D-04
7	0.3275734451D 00	0.2306894923D-04
8	0.3270001735D 00	0.2309677767D-04
9	0.3266852982D 00	0.2311134342D-04

ND= 1 SAMPLING PERIOD= 3.26511D-01SEC AMPLITUDE= 2.31189D-05 N= 9

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 5.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3265114680D 00	0.2311885352D-04
1	0.3134437038D 00	0.2496359109D-04
2	0.3043395095D 00	0.2615638510D-04
3	0.2983602071D 00	0.2692653836D-04
4	0.2946473529D 00	0.2740556060D-04
5	0.2924408293D 00	0.2768859223D-04
6	0.2911717454D 00	0.2784892157D-04
7	0.2904579278D 00	0.2793712255D-04
8	0.2900603812D 00	0.2798493040D-04
9	0.2898360556D 00	0.2801133966D-04

ND= 1 SAMPLING PERIOD= 2.89699D-01SEC AMPLITUDE= 2.80285D-05 N= 9

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 4.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2896990149D 00	0.2802847803D-04
1	0.2794890678D 00	0.3001133103D-04
2	0.2729917247D 00	0.3146410314D-04
3	0.2689976369D 00	0.3242627184D-04
4	0.2666235114D 00	0.3301513461D-04
5	0.2652524683D 00	0.3335574996D-04
6	0.2644772430D 00	0.3354573933D-04
7	0.2640421182D 00	0.3365027538D-04
8	0.2637896353D 00	0.3371108549D-04
9	0.2635933842D 00	0.3377144366D-04
10	0.2635372810D 00	0.3378429577D-04
11	0.2634699260D 00	0.3382358768D-04
12	0.2628642669D 00	0.3435228752D-04
13	0.2633101399D 00	0.3394466571D-04
14	0.2635730871D 00	0.3370494245D-04
15	0.2635730069D 00	0.3368040171D-04

ND= 1 SAMPLING PERIOD= 2.63573D-01SEC AMPLITUDE= 3.36804D-05 N=15

Figure 2-8b.

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 3.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2635730069D 00	0.3368040171D-04
1	0.2557200863D 00	0.3568292423D-04
2	0.2512815177D 00	0.3709936920D-04
3	0.2488011387D 00	0.3799526518D-04
4	0.2474297532D 00	0.3851949943D-04
5	0.2466773243D 00	0.3881190135D-04
6	0.2462623409D 00	0.3897256217D-04
7	0.2460172960D 00	0.3907037428D-04
8	0.2456114935D 00	0.3934850366D-04
9	0.2459718360D 00	0.3864238696D-04
10	0.2458310873D 00	0.3891659330D-04
11	0.2457483856D 00	0.3904801434D-04
12	0.2460093270D 00	0.3911037421D-04
13	0.2457639879D 00	0.3924292727D-04
14	0.2453306847D 00	0.3981897911D-04
15	0.2456430421D 00	0.3930859796D-04

ND= 1 SAMPLING PERIOD= 2.45643D-01SEC AMPLITUDE= 3.93086D-05 N=15

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 2.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.2456430421D 00	0.3930859796D-04
1	0.2403415437D 00	0.4039844502D-04
2	0.2382262614D 00	0.4068682338D-04
3	0.2374380085D 00	0.4064485820D-04
4	0.2371315275D 00	0.4054959708D-04
5	0.2369781829D 00	0.4050046427D-04
6	0.2368591609D 00	0.4052036897D-04

ND= 1 SAMPLING PERIOD= 2.36794D-01SEC AMPLITUDE= 4.05412D-05 N= 6

LST SYSTEM-NUMERICAL SOLUTION OF DISCRETE DESCRIBING FUNCTION
TWO AXIS-EQUAL AMPLITUDE CASE, K2= 1.000D-01, K3= 1.000D-01
GAMMA= 1.38000D 07 N= 4 PHI= 1.00000D 01

ITERATION	SAMPLING PERIOD	AMPLITUDE
0	0.3223799858D 00	0.1674694093D-04
1	0.3217327985D 00	0.2144602416D-04
2	0.3479304133D 00	0.1476851826D-04
3	0.3560044890D 00	0.1469518706D-04
4	0.3593430003D 00	0.1468487728D-04

ND= 1 SAMPLING PERIOD= 3.60729D-01SEC AMPLITUDE= 1.46858D-05 NT= 4

Figure 2-8c.

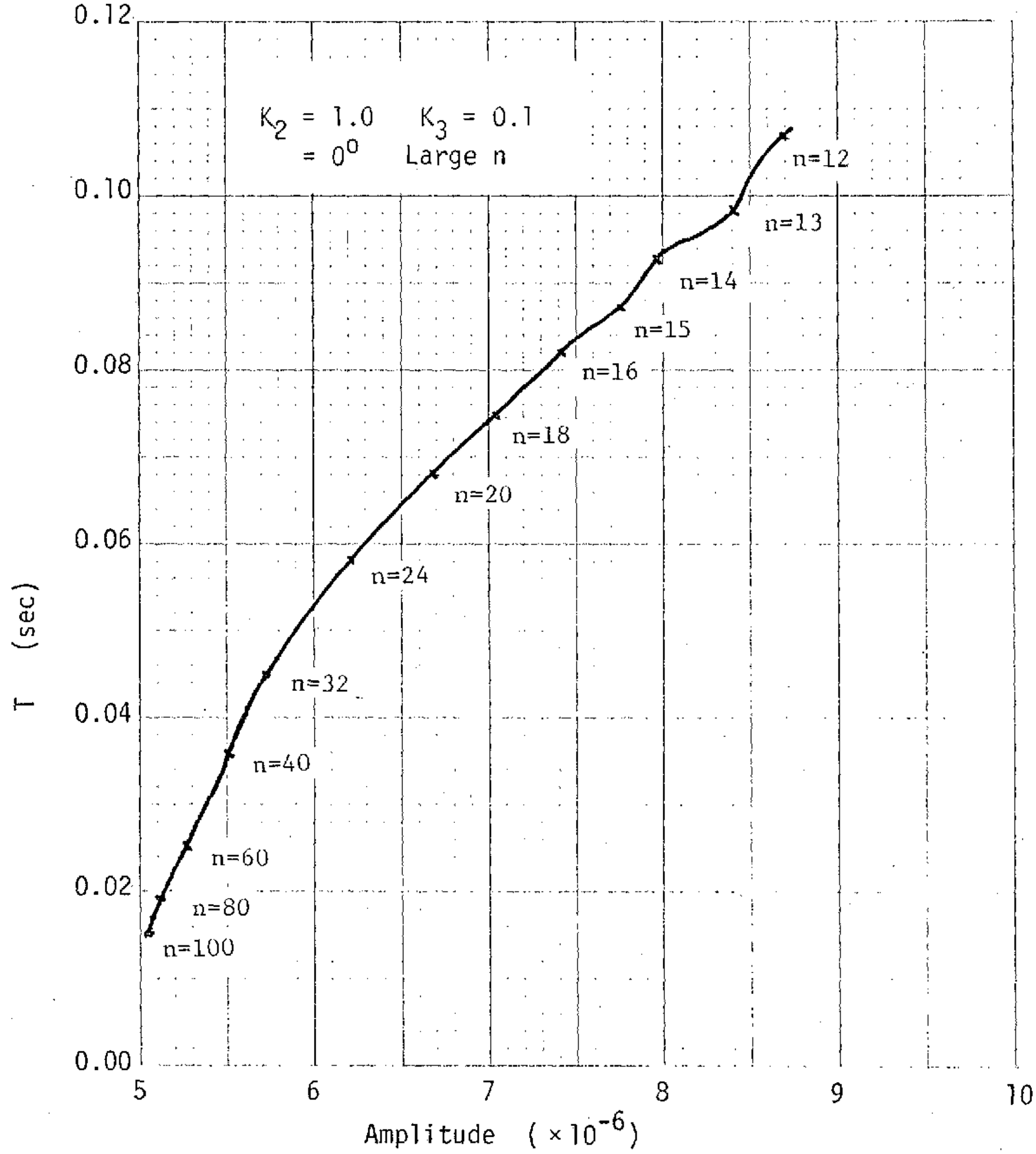

Figure 2-9. Amplitude and frequency $(2\pi/nT)$ of self-sustained oscillations for various sampling periods in the discrete-data two-axis LST system; $\gamma = 1.38\times10^{7}$.

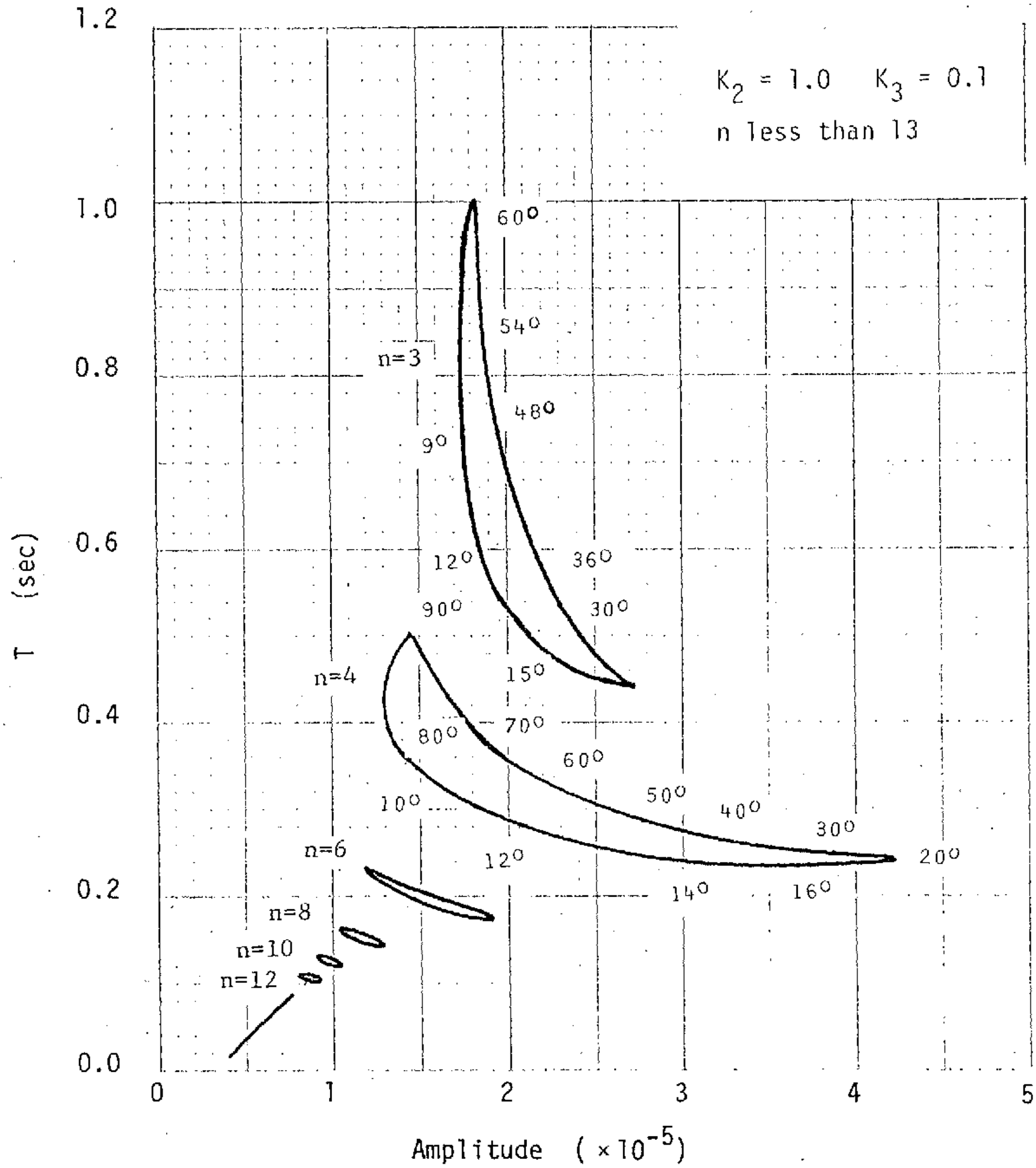

Figure 2-10. Amplitude and frequency ($2\pi/nT$) of self-sustained oscillations for various sampling periods in the discrete-data two-axis LST system; $\gamma = 1.38\times10^7$.

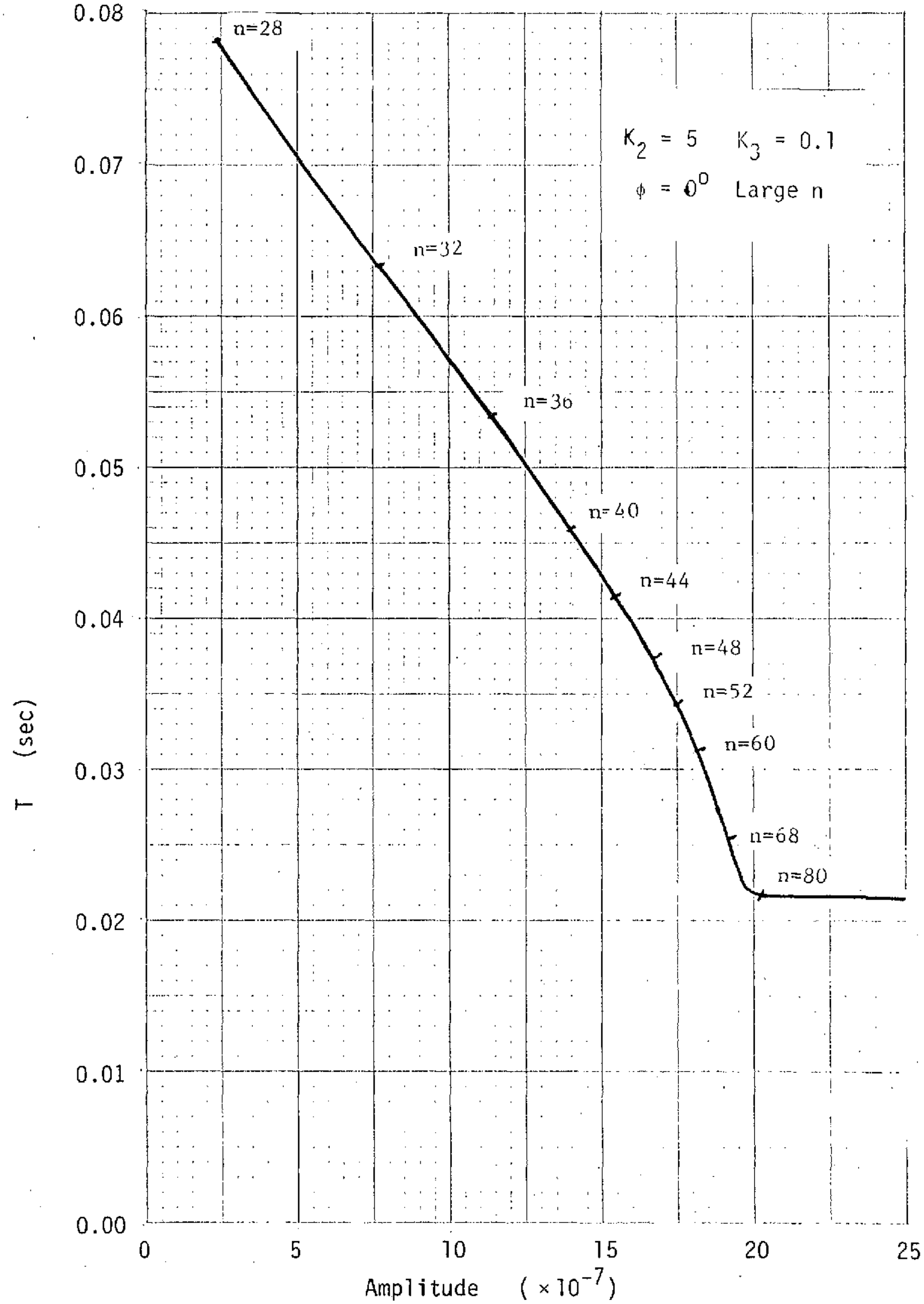

Figure 2-11. Amplitude and frequency ($2\pi/nT$) of self-sustained oscillations for various sampling periods in the discrete-data two-axis LST system; $\gamma = 1.38\times10^{7}$.

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